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THE CONTROL OF HOG CHOLERA, WITH A DISCUSSION OF THE RESULTS OF FIELD EXPERIMENTS.

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CONTENTS.

	Page.
Nature and prevalence of hog cholera	1
The serum method of control	4
Field experiments	5
Results of field experiments	7
The combating of hog cholera	13
Summary	17

NATURE AND PREVALENCE OF HOG CHOLERA.

During the past three decades hog cholera has probably caused greater loss to the farming communities of the United States than any other animal plague. Originally appearing in the States of the Atlantic seaboard and of the Ohio Valley, it has gradually spread over the entire country, until at the present time the disease may be said to exist in endemic form in all parts of the United States. It is not always equally prevalent, but, on the contrary, at intervals assumes the character of a severe epizootic, sweeping over the entire country, only later to subside for a period of years, after which it again increases in prevalence. This characteristic of periodic prevalence is well illustrated by the accompanying chart (fig. 1) prepared from statistics collected by the Bureau of Crop Estimates of the United States Department of Agriculture.

For many years it has been known that hog cholera is an infectious disease, produced by a specific microorganism which develops in the bodies of affected hogs. Only swine are susceptible. The existence of the infectious agent in the bodies of infected hogs may be readily demonstrated, but all efforts to isolate and grow the virus in laboratories have resulted in failure. The microorganism in this respect resembles those which cause foot-and-mouth disease of animals and the very fatal yellow fever of human beings. The fact that the precise nature of the microorganism causing hog cholera has not been determined does not seem, however, to be an insuperable barrier to successful methods of control, for it is recognized that the virus is propagated exclusively in the bodies of infected hogs and from them conveyed to others. Knowing this, at first thought the problem of control would seem to be comparatively simple. Quarantine or slaughter of infected herds, supplemented by careful disinfection, are clearly indicated as effective measures. But these are drastic measures, and before their adoption the cost of their enforcement must be weighed against the chances of success and the relative advantages of other modes of procedure.

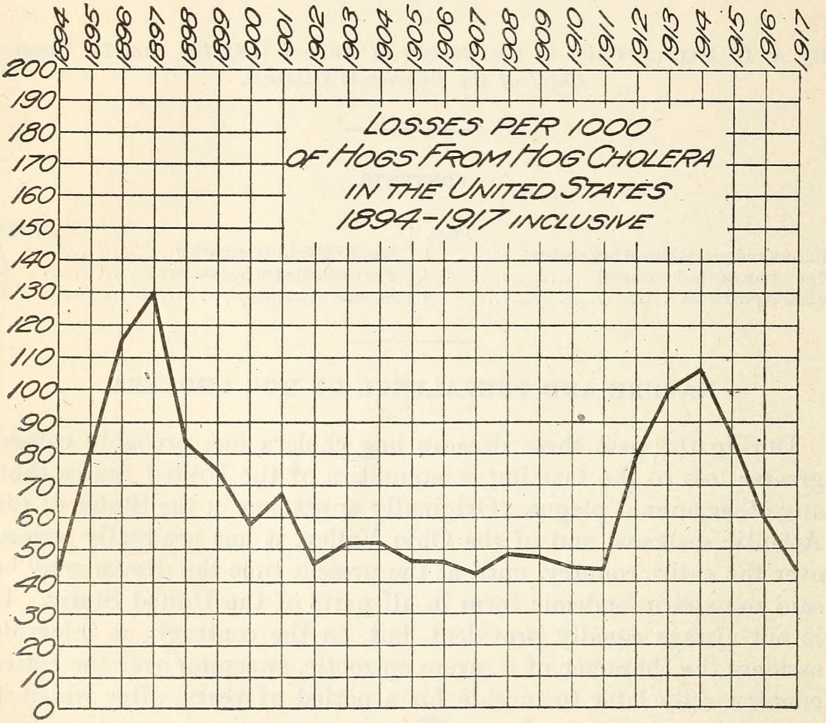

FIG. 1.—Losses from hog cholera in the United States, years ending March 31, 1894–1917, inclusive.

In Canada there are several million hogs, but cholera has never been widespread there. When it has occurred the veterinary authorities have promptly checked the disease by quarantining the farm, slaughtering all hogs, disinfecting the premises, and prohibiting the restocking of the farm for a period of three months. In Canada, then, we apparently have an instance of the successful control of cholera by quarantine, disinfection, and slaughter. In Great Britain, however, the case is different. There the disease is as widespread as it is in the United States. There, as in Canada, for many years the policy of quarantine, slaughter, and disinfection has been followed, but not with the same success. Hog cholera still exists and at certain times shows the same tendency to increase that is observed in the United States, where no country-wide systematic effort at control has ever been attempted. A number of factors have no doubt operated to prevent success in Great Britain by methods which have seemed to be effective in Canada. Among the most important of these may be mentioned a large number of hogs in proportion to area, wide dissemination of the disease, and numerous avenues of communication and traffic through which the disease may be spread.

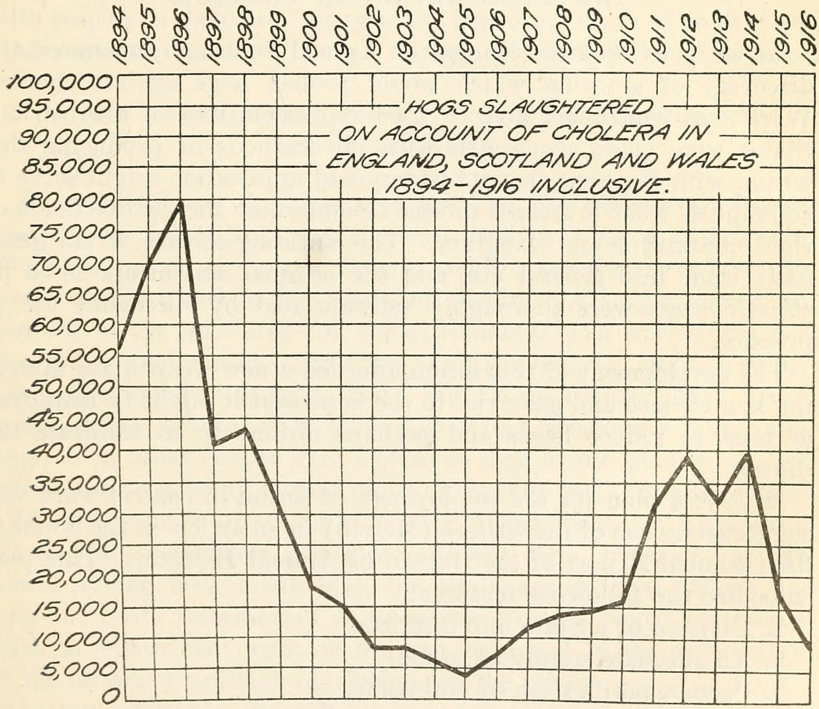

FIG. 2.—Course of hog cholera in Great Britain, 1894 to 1916.

The course of the disease in Great Britain during the past 23 years is indicated in figure 2.

With the experience of Great Britain as an example, we in the United States with widespread disease, great numbers of hogs, and many channels of communication to serve as conveyors of infection could certainly not enter upon a campaign of eradication by quarantine and slaughter with any assurance of success, despite the fact that at first glance the problem appears to be simple. Then, too, the cost must be considered. An army of thousands of employees would be required, millions of dollars would be needed for the reimbursement of owners, and the interference with the hog industry of the country would be so great that any such campaign for the eradication of hog cholera instead of proving a boon might come to be regarded by the hog raisers of the country as a calamity.

With the above ideas in mind, the United States Bureau of Animal Industry has given much study to the development of some practical working plan for controlling losses from hog cholera. With this object in view, laboratory researches and field experiments have been continuously prosecuted for a number of years.

THE SERUM METHOD OF CONTROL.

As early as 1904 the Bureau of Animal Industry announced the discovery of a serum which would protect hogs against cholera. Work was continued, and in 1908 representatives of the various States were made acquainted with the methods of producing this serum, with the hope that its widespread application might serve to accomplish what it seemed unwise to undertake through methods of rigid quarantine and slaughter. This anti-hog-cholera serum gradually came into general use, and the original statements as to its efficaciousness were thoroughly substantiated by successful use in practice.

The development of this serum afforded a new weapon for attacking hog cholera and gave rise to the hope that it might be employed at least to reduce losses and perhaps ultimately to eradicate the disease.

In 1908 a plan for the employment of serum in control work was suggested by one of the writers (Melvin) in an article in the Twenty-fifth Annual Report of the Bureau of Animal Industry. This plan embodied the following features:

1. Division of a State into districts.
2. An adequate supply of serum.
3. Prompt notification of outbreaks.
4. Quarantine and disinfection of infected premises.
5. Prompt treatment of infected herds with serum.
6. Immunization of neighboring herds by inoculation with serum and virus (simultaneous inoculation).

This plan seemed to possess many advantages over the method of quarantine and slaughter. If properly carried out, a large proportion of each infected herd should be saved and become exceptionally valuable on account of the immunity which would be established. The business of the farmer would not be seriously interfered with, as all new stock could be immunized before being brought upon the infected premises, while the immunization of neighboring herds probably would lessen greatly the chances of spread. All things considered, then, this plan seemed to be one that would enlist the cooperation of farmers and at the same time do much toward reducing the losses from the disease.

On July 1, 1913, the Congress of the United States appropriated the sum of $75,000 to be used for the purpose of "demonstrating the best method of preventing and eradicating hog cholera," and later, on February 23, 1914, supplemented this with an additional appropriation to permit work on a much larger scale. With these funds extensive field experiments have been carried on, and it is the purpose of this paper to discuss the results of these experiments, both with respect to their bearing upon the broad questions of control and upon certain important, though minor, questions that are involved.

FIELD EXPERIMENTS LOOKING TO THE CONTROL OF HOG CHOLERA.

As stated above, the first appropriation for field work became available on July 1, 1913, and the work itself was begun at that time. The plan was to try out in several small areas the procedure suggested and outlined in the preceding section. A single county was adopted as the unit area for the experiments, and during the first year work was carried on in three counties, namely, Dallas County, Iowa, Montgomery County, Ind., and Pettis County, Mo. Later, in the spring of 1914, when more money had become available, other counties in other States were added, so that in the summer of 1914 active work was being carried on in 14 counties in 12 different States.

In each county the United States Department of Agriculture placed three veterinary inspectors and one clerk, previous arrangements having been made with the State agricultural college and with the State veterinarian or live-stock sanitary board for cooperation in educational work on the one hand and in the enforcement of the necessary sanitary regulations on the other.

At the beginning, in each county steps were taken with the aid of the State agricultural college to inform farmers of the objects sought, of the characteristics of the disease and channels which serve to convey it, and of the importance of promptly reporting outbreaks. A census of hogs and of losses from diseases was taken, and the existing centers of infection were located as far as possible. To obtain the cooperation of the farmers, which is an essential to success in work of this nature, organizations of farmers were formed in each township, consisting of one leader and eight district representatives. Each of the district representatives was charged with the duty of reporting the occurrence of disease among hogs in his district to the federal inspector in charge. The State veterinarian was to have all local stockyards and loading places cleaned and disinfected and to cooperate with Federal officials by instructing owners of infected premises concerning methods of disinfection, and by supervising such operations. The Federal inspectors, besides participating in the sanitary work and the work of organization, were particularly charged with the administration of serum to infected herds and the immunization of neighboring herds. To avoid antagonism on the part of farmers, a partial quarantine only of infected premises was enforced.

It will thus be seen that work was done along three principal lines, as follows:

1. Organization and education.
2. Sanitation.
3. Serum treatment.

In practically all of the counties hog cholera was widespread when the work was begun, and it was soon found that many difficulties lay in the way of carrying out the plan proposed. In the first place the great prevalence of disease soon rendered it impracticable to attempt the immunization of healthy herds on farms surrounding an infected farm, for the reason that the supply of serum and the number of inspectors were insufficient to carry out that plan. For each infected herd it would have been necessary to treat from 4 to 6 neighboring herds. This was only one of the difficulties encountered. In the beginning of the work, particularly, the farmers as a whole were apathetic and showed little interest in the experiments. Many were skeptical concerning the value of the serum, and it was not unusual to find in districts supposed to be canvassed by cooperating farmers herds which had already been infected for weeks without any report whatever of the condition having been made to the inspectors.

Thus it will be seen that at the very outset the carefully prepared plan of procedure was found to be impracticable, chiefly because of extensive infection and the lack of interest displayed by the farmers themselves. Therefore a change in the details of the work was decided upon. The immunization of healthy herds in the neighborhood of outbreaks was abandoned. More time was given to educational work through addresses to assemblages of farmers and by personal visits to individuals residing in the vicinity of infected farms. This educational work was directed particularly toward explaining the ways in which hog cholera is spread and urging the importance of sanitation and the establishment of a voluntary quarantine against infected farms. The properties and limitations of anti-hog-cholera serum were also fully discussed.

From what has been said it will be seen that these experiments for the study of the control of hog cholera partook only to a small degree of the characteristics of the usual control methods. Strict sanitary police measures were replaced by organization and education, and force was replaced by argument and explanation. Now, after three years of effort, the original indifference to the work has, for the most part, been replaced by genuine interest and willingness to cooperate on the part of farmers. It is interesting to consider the results.

RESULTS OF FIELD EXPERIMENTS.

The results of this work may be considered from four different viewpoints: (1) Cost of the work; (2) prevalence of the disease; (3) losses from cholera; and (4) condition of the hog industry.

COST OF THE WORK.

The principal item of expense in connection with this work is the salary list of field inspectors. Next in importance is the cost of the serum, and to these two items must be added charges for transportation, equipment, and general supervision. The cost per county to the Federal Government has averaged a little less than $9,000 a year. In most cases the amount expended by the States has been small, and it is safe to say that the total expenditures on the average have not exceeded $10,000 per county per annum.

PREVALENCE OF THE DISEASE.

The actual effect of this work upon the prevalence of hog cholera is difficult to determine. As shown by figure 1, the disease, considering the country as a whole, varies in prevalence from year to year. Furthermore, these experiments began at a time (1913) when hog cholera had almost reached the pinnacle of one of the periodic waves of prevalence. During 1914 there was a decrease in some sections and in 1915 the disease was on the decline in the country as a whole, though it is true that in some localities it did not materially abate. Bearing these facts in mind, we may consider the number of outbreaks (that is, individual farms upon which the disease appeared) that occurred in the several areas during the experimental period, as shown in Table 1.

TABLE 1.—*Number of infected farms in counties where experimental work was carried on, 1913–1916.*

State.	County.	Farms infected.		
		1913[1]	1914	1915
Georgia	Decatur		764	250
Idaho	Twin Falls		92	103
Indiana	Hendricks		446	247
Do	Montgomery	376	324	393
Iowa	Clay		130	32
Do	Dallas	324	302	82
Kansas	Marshall		278	48
Kentucky	Henderson		157	163
Michigan	Branch		96	19
Minnesota	Renville		616	74
Missouri	Pettis	211	324	281
Nebraska	Gage and Johnson		420	86
South Dakota	Davison		269	116
Tennessee	Maury		517	462

[1] Only 3 experimental counties in 1913.

It is unfortunate that the data contained in this table do not cover a greater period of time and that similar information can not be furnished for a number of counties immediately surrounding each experimental county. Nevertheless considerable information is afforded by the table in its present condition.

For the purposes of analysis it will be sufficient to consider the records of the three original counties. The table shows that with respect to prevalence of cholera these counties are not in agreement, for while the number of outbreaks steadily declined in Dallas County, Iowa, they increased slightly in Montgomery County, Ind., in 1915, while in Pettis County, Mo., though somewhat reduced in 1915, they yet exceeded the record of 1913. What is the explanation of these figures and how are these differences to be accounted for?

A separate consideration of each of these counties is necessary to obtain an answer to these questions. As stated above, no figures are available on the number of outbreaks in surrounding counties during the same period. However, some data relative to total losses from cholera in neighboring territory have been obtained, and this information enables us better to understand the records of these three experimental counties.

With reference to Dallas County, the table shows that the disease was most prevalent in 1913, slightly reduced in 1914, and greatly reduced in 1915. It is a fact that hog cholera in the State of Iowa as a whole followed somewhat the same course, being much less in extent in 1915 than in either of the two preceding years. Furthermore, a carefully prepared estimate, following personal investigations of the losses of hogs in 1913, 1914, and 1915 in seven neighboring counties where no organized fight against cholera was being carried on, shows the same progressive decrease that occurred in Dallas County. The reduced losses in these counties must have been due in the main to a decreasing prevalence of disease. It is clear, then, that although the experimental work may have served to keep the number of outbreaks lower than it would otherwise have been, it can not be said that the reduction in outbreaks in Dallas County, Iowa, was due to that work alone.

It is very interesting to compare the records from Montgomery County, Ind., with those from Dallas County, Iowa. In the former area the disease during the three years of work has shown little change in prevalence. It decreased slightly in 1914, only to increase in about the same degree in 1915. It is a matter of record that throughout the State of Indiana hog cholera showed no indication of decreasing in prevalence during the same period. On the contrary there were indications of increased prevalence in the State, taken as a whole, particularly in 1915. A personal canvass of four Indiana counties adjoining Montgomery County showed that in them the percentage of loss from cholera increased steadily during the three years. In other words, in these neighboring counties where no systematic work was done the disease seems to have pursued about the same course with respect to prevalence as in Montgomery County, where continued work was carried on. Of course the actual losses in Montgomery County were much less than in the surrounding counties, due to more general use of serum.

In Pettis County, Mo., the results were much the same, though it may be noted that there was no increase in prevalence there in 1915. In counties adjoining Pettis there appeared to be a distinct increase in the percentage of hogs lost from cholera.

It seems unnecessary to consider individually the remaining experimental counties where only two years' work has been done as against three years' work in those just discussed.

The fact that the control work did not serve to eradicate the disease is self-evident. Considering the records of outbreaks in the three original counties in comparison with the losses in neighboring counties during the years 1914 and 1915, we must conclude that the reduced prevalence in most of the experimental counties is probably a fortuitous circumstance, and at most only partly attributable to the experimental control work. It must be borne in mind, however, that these conclusions refer only to prevalence of outbreaks of disease and not to losses from cholera, for with regard to losses the case is entirely different.

LOSSES FROM CHOLERA.

It will be remembered that in all of the experimental counties one of the duties of the field inspectors was to search out the infected farms and apply the serum treatment. This work had a dual purpose—to save the hogs and to cut short the disease, thereby minimizing the chances of its spreading. We have seen that the second object was not attained to any appreciable degree. The effect of the work upon the actual losses of hogs from disease is a subject that requires more extended consideration.

TABLE 2.—*Statistics of hogs raised and hogs that died of hog cholera in 14 experimental counties, 1912–1915.*

County and State.	Date work begun.	1912			1913		
		Hogs raised.	Hogs died.		Hogs raised.	Hogs died.	
		Number.	*Number.*	*Per 1,000.*	*Number.*	*Number.*	*Per 1,000.*
Decatur, Ga	Aug. 25, 1914	48,418	8,546	176	52,797	12,225	231
Twin Falls, Idaho	July 6, 1914	47,673	3,163	66	82,563	12,978	157
Hendricks, Ind	Sept. 3, 1914	63,259	13,532	204	72,211	12,908	178
Montgomery, Ind	July 5, 1913	77,403	24,404	315	78,813	5,136	64
Clay, Iowa	July 10, 1914	73,065	25,000	342	87,953	30,266	344
Dallas, Iowa	July 1, 1913	84,618	19,821	234	118,550	12,000	101
Marshall, Kans	July 6, 1914	65,294	3,853	59	72,036	7,230	100
Henderson, Ky	July 22, 1914	35,814	8,743	244	30,866	3,934	127
Branch, Mich	May 28, 1914	46,170	1,209	25	55,338	4,039	72
Renville, Minn	May 8, 1914	65,790	8,998	136	85,699	43,403	564
Pettis, Mo	Aug. 1, 1913	59,661	18,853	316	107,151	6,386	59
Gage and Johnson, Nebr	Mar. 31, 1914	76,591	5,445	70	80,949	6,012	74
Davison, S. Dak	Oct. 6, 1914	39,920	2,270	36	57,695	16,248	281
Maury, Tenn	July 21, 1914	73,234	8,399	114	69,787	6,360	91
Total		856,910	152,236	177	1,052,408	179,125	170

County and State.	Date work begun.	1914			1915		
		Hogs raised.	Hogs died.		Hogs raised.	Hogs died.	
		Number.	*Number.*	*Per 1,000.*	*Number.*	*Number.*	*Per 1,000.*
Decatur, Ga	Aug. 25, 1914	55,000	11,618	211	80,000	7,595	95
Twin Falls, Idaho	July 6, 1914	100,000	1,269	12	150,000	1,487	10
Hendricks, Ind	Sept. 3, 1914	85,955	4,065	42	107,205	3,075	29
Montgomery, Ind	July 5, 1913	85,119	2,296	26	141,000	5,179	37
Clay, Iowa	July 10, 1914	89,874	4,209	46	92,703	578	6
Dallas, Iowa	July 1, 1913	138,320	6,810	49	124,540	1,939	16
Marshall, Kans	July 6, 1914	65,592	3,432	52	101,207	561	5
Henderson, Ky	July 22, 1914	20,000	2,907	145	20,000	1,980	99
Branch, Mich	May 28, 1914	57,878	715	12	60,000	210	4
Renville, Minn	May 8, 1914	100,722	5,069	50	108,360	347	3
Pettis, Mo	Aug. 1, 1913	136,030	5,847	42	149,633	2,906	19
Gage and Johnson, Nebr	Mar. 31, 1914	71,059	3,541	49	78,164	744	9
Davison, S. Dak	Oct. 6, 1914	45,430	4,891	107	49,000	1,261	26
Maury, Tenn	July 21, 1914	70,250	3,194	45	72,832	3,103	42
Total		1,121,229	59,863	53	1,334,644	30,965	23

Table 2 gives in condensed form a record of losses from cholera in each of the 14 experimental counties for the years 1912 to 1915, inclusive. The table also shows the date upon which work was begun in each county. It is important to keep this date in mind in studying the table to determine the effect of the work upon the course of the disease, for as the work began 12 months earlier in some counties than in others the effects naturally became apparent in different years. The figures given are not merely estimates, but, on the contrary, were obtained by a personal canvass of the counties and may therefore be regarded as reasonably exact. The figures in the columns showing the total deaths represent the total losses of hogs from cholera. A large proportion of these occurred either in herds where no treatment was applied, because the disease was not reported, or took place in herds before inspectors could apply the treatment. Striking evidence of this is obtained by comparing the total deaths from cholera in 1914 and 1915 with the deaths among treated hogs during the same period. For example, the total deaths in 1914 numbered 59,863, of which only 13,985 hogs had been treated. In 1915, though there was a total loss of 30,965 hogs, only 9,148 of these had been treated. The prompt treatment of all hogs on infected farms undoubtedly would have reduced the losses still further.

Inasmuch as the experimental work was carried on in only 3 of the 14 counties in 1913, that year may be regarded as a fair representative of conditions in the 14 counties, taken as a whole, when the work was begun. By comparing the death rate in 1913 with that in 1914 and 1915, we find that not only did the actual losses from cholera steadily diminish, but that the ratio of deaths per thousand decreased to an even greater extent, due to increased hog production. In 1914 there were 119,262 fewer hogs lost than in 1913, and in 1915, 28,898 fewer than in 1914. The death rates for the same years were: 1913, 170 per thousand; 1914, 53 per thousand; and 1915, 23 per thousand.

During this same period we find that the number of hogs raised was constantly increasing, the number being 1,052,408 in 1913, 1,121,229 in 1914, and 1,334,644 in 1915, an increase of 282,236 hogs in two years.

Again, the question naturally arises as to whether this remarkable improvement with respect to losses and to the conditions of the industry is to be referred primarily to the natural subsidence of the disease or to the experimental control work. To decide this we must have recourse to comparison with neighboring counties. It has been possible to obtain what are believed to be reasonably accurate estimates of hogs raised and hogs lost during 1913, 1914, and 1915 in several counties surrounding each of seven of the experimental counties, namely, Dallas County, Iowa, Pettis County, Mo., Montgomery County, Ind., Clay County, Iowa, Gage and Johnson Counties, Nebr., Marshall County, Kans., and Renville County, Minn. The experimental work was begun in the first three of these counties in 1913 and in the remaining four in 1914. Therefore in making our comparisons it is necessary to divide the experimental counties into two groups, one representing counties in which work was done for three years, and the other those in which only two years' work was carried out. Table 3 contains the data relative to the first group and Table 4 those of the second group.

TABLE 3.—*Comparison of hogs raised and lost in 3 original experimental counties and 15 surrounding counties, 1912–1915.*

Counties.	1912			1913			1914			1915		
	Hogs raised.	Hogs lost.		Hogs raised.	Hogs lost.		Hogs raised.	Hogs lost.		Hogs raised.	Hogs lost.	
	Number.	*Number.*	*Per 1,000.*	*Number.*	*Number.*	*Per 1,000.*	*Number.*	*Number.*	*Per 1,000.*	*Number.*	*Number.*	*Per 1,000*
Average of 3 experimental counties	73,984	21,025	284	101,504	7,840	77	119,823	4,984	41	138,391	3,341	24
Average of 15 surrounding counties	....	....	....	80,993	14,858	183	67,888	7,977	117	58,021	5,593	96

Experimental counties: Dallas, Iowa; Montgomery, Ind.; and Pettis, Mo. Experimental work began in 1913.

TABLE 4.—*Comparison of hogs raised and lost in 4 experimental counties and 18 surrounding counties, 1913–1915.*

Counties.	1913			1914			1915		
	Hogs raised.	Hogs lost.		Hogs raised.	Hogs lost.		Hogs raised.	Hogs lost.	
	Number.	*Number.*	*Per 1,000.*	*Number.*	*Number.*	*Per 1,000.*	*Number.*	*Number.*	*Per 1,000.*
Average of 4 experimental counties	81,659	21,727	266	81,811	4,062	49	95,108	557	5
Average of 18 surrounding counties	53,997	16,734	309	44,028	7,230	164	47,113	3,877	82

Experimental counties: Clay, Iowa; Gage and Johnson, Nebr.; Marshall, Kans.; and Renville, Minn. Experimental work began in 1914.

Tables 3 and 4 seem to show clearly the effects of the experimental work. Considering first Table 3, it is remarkable to see the great reduction in losses from cholera in Dallas, Montgomery, and Pettis Counties in 1913 as compared with 1912, and to note that the loss per thousand was but little more than one-third of that which occurred in 1913 in the 15 neighboring counties where no experimental work was being done. It is seen also that the loss per thousand has continued to decrease during 1914 and 1915 in both cases, and that in the case of 3 experimental counties it has remained constantly from two and one-half to four times less than in the 15 surrounding counties. These results were obtained notwithstanding the fact that in the experimental counties considerably more hogs were being raised.

Table 4 presents additional data obtained from a different set of counties. It shows that in the four experimental areas consisting of Clay County, Iowa, Gage and Johnson Counties, Nebr., Marshall

County, Kans., and Renville County, Minn., there was a marked reduction of losses, both absolute and relative, immediately following the beginning of the control work, and that the average number lost in each experimental county in comparison with the average loss in neighboring counties was reduced from somewhat more than an equal number in 1913 to less than one-seventh in 1915.

Furthermore, it is important to note that Tables 3 and 4 both show that the work did not in any way injure the business of hog raising, but on the contrary seems to have aided it greatly. The very large increase in the number of hogs raised in the experimental counties, as compared with a languishing industry in the surrounding counties, is one of the most encouraging indications furnished by the data.

It will be remembered that the experimental work was based principally upon (1) an educational campaign, designed to stimulate the interest and secure the cooperation of farmers, and (2) the prompt treatment of infected herds with serum. This mode of procedure resulted in greatly increased hog production and greatly reduced mortality from cholera. It seems reasonable to ascribe the increase in hog production to the educational work, and the reduced losses from disease to the use of anti-hog-cholera serum. Table 5 summarizes the results following the use of serum in infected herds.

TABLE 5.—*Results of treatment in infected herds during 1913, 1914, and 1915.*

Condition of hogs and method of treatment.	Hogs treated.	Hogs died.	
	Number.	*Number.*	*Per cent.*
Hogs sick when treated:			
Simultaneous	2,448	713	29.1
Serum alone	83,099	23,990	28.8
Total sick hogs treated	85,547	24,703	28.8
Hogs apparently well when treated:			
Simultaneous	81,289	3,070	3.7
Serum alone	67,300	3,063	4.5
Total healthy hogs treated	148,589	6,133	4.1
Total hogs treated	234,136	30,836	13.1

Table 5, which shows that only 13.1 per cent of 234,136 hogs treated in infected herds were lost, seems to demonstrate clearly that potent serum is effective in preventing losses from cholera and that the reduced losses in the experimental counties are to be ascribed directly to the use of the serum.

THE COMBATING OF HOG CHOLERA.

There are two facts which stand out clearly with respect to hog cholera. First, eradication or total extirpation of the disease in the United States at this time is impracticable. Second, though eradication is impossible, it is entirely practicable in large part to eliminate, by the use of serum, the enormous losses which annually are caused by the disease.

We are firmly convinced that, for the present, the greatest good is to be accomplished by bending every effort toward the rational use of serum so as to curtail the losses of hogs, rather than by attempting nation-wide eradication, which on account of the many factors involved we must regard as impossible. It is well, therefore, to consider how the most effective work may be done, and in particular what duties devolve upon the State and Federal Governments.

First of all we must recognize the fact that success or failure will depend upon the farmer himself. His interest and intelligent cooperation are the foundation stones upon which this work must rest. Therefore, education of farmers in matters pertaining to hog cholera takes first place. However, the importance of organization must not be lost sight of. Every farmer should be interested in and have knowledge of the conditions prevailing in neighboring herds and should see to it that his neighbors are promptly informed of any trouble that may arise in his own herd. To promote this cooperation, some form of organization of farmers is essential.

The whole purpose of this education and organization is to enable the farmers intelligently to avail themselves of the means of saving their hogs; therefore knowledge on the part of the farmer as to what to do and how to do it will be of little avail unless the needed facilities are supplied. Thus, arrangements must be made for ready availability of good serum and of the instruments required for its injection by men sufficiently skilled to insure proper use.

We may expect success in controlling losses from cholera when the following four conditions are met: (1) A farming community that knows hog cholera, the ways in which it is spread, and the best methods of combating it. (2) A community so organized that every farmer will be ready to help his neighbors by informing them of the existence of cholera wherever this may come to his notice, and where every farmer knows where to get good serum quickly. (3) Readily available serum at reasonable prices. (4) A sufficient number of skilled men to apply the serum.

In order to attain these desired conditions the united efforts of State and Federal Governments are required, for, while the prevention of losses in individual localities is a matter of local concern only, this disease, being so widespread and so disastrous in its effects upon the welfare and prosperity of the farmers generally, also affects the entire population of the country through the destruction of so large a proportion of the food-producing animals.

It seems clear, therefore, that the Federal Government should lend its aid in all cases where State officials or other local agencies are in a position to offer reasonable cooperation. Under such an arrangement the duties of Federal and State officials may be outlined as follows:

DUTIES OF UNITED STATES DEPARTMENT OF AGRICULTURE.

The United States Department of Agriculture should supply a corps of trained veterinarians, one or more to be assigned to each State, where arrangements for cooperative work can be made. The duties of these field men would be to work in direct cooperation with the constituted authorities of the States in organizing the farmers, making addresses on cholera and means of control, and explaining and demonstrating the best methods of applying serum. These Federal field men should not remain permanently in one locality, but after working over a selected area should proceed to another and work there with State authorities as in the first, the idea being for them to help in organizing and coordinating the work, but ultimately leaving the administration entirely in the hands of State authorities.

The department should continue to inspect and supervise establishments engaged in the preparation of anti-hog-cholera serum for interstate shipment, the prime object of such inspection being to insure, in so far as supervisory inspection may accomplish that end, the purity and potency of the products which farmers will be encouraged to use.

DUTIES OF STATE AUTHORITIES.

The State authorities should supply a corps of veterinarians who are particularly skilled not only in matters pertaining to hog cholera, but in the art of teaching and organizing. These men should work directly with the Federal officers and along the same lines, except that their work should perhaps go more into detail and their contact with farmers and farmers' organizations should be more intimate than would be the case with the Federal employees. They should also lend their cooperation to representatives of the live-stock sanitary board or chief veterinary officer of the State, so as to promote the observance of the sanitary rules which may be of the greatest assistance in limiting the number of outbreaks to be dealt with.

The State live-stock sanitary board or the State veterinarians should promulgate regulations designed to reduce the channels through which cholera may be spread, but framed at the same time with the idea of avoiding serious interference with the hog industry. At the same time a campaign of education relative to sanitation should be carried on in cooperation with the State college and the Federal Government. A force of men sufficient to attend to this work and to take part in the intensive work in selected areas would, of course, be needed.

The State live-stock sanitary board or the State veterinarian (except in States where such work is delegated to the State college) should maintain close supervision and inspection of all establishments producing anti-hog-cholera serum for use only within the State. It would not be essential for such inspection to be carried out at plants where Federal inspection is maintained. There appears to be no good reason for duplicating this work, but there is much reason for insisting upon the same standard of excellence for all serum that is to be sold to farmers, and this can be accomplished only by uniform methods of inspection.

CONTROL OF SERUM AND VIRUS.

In addition to the duties described above for the three organizations concerned, there is certain other work to be done which might perhaps be assigned to either the one or the other of the two State organizations, the decision in this respect to be governed by local conditions and by the State laws in force. Among such duties may be mentioned the control of the use of virus in immunization work and the arrangement for the maintenance of supplies of serum, if such supplies are not already available, by private or public serum plants and in localities where all farmers may quickly procure it. This last-named need is of course essential, for when serum is needed it is needed quickly, and any delay in this respect might entirely nullify all of the other work. There is no justification for the expenditure of large sums to demonstrate and explain the use of serum unless serum can be obtained when needed. This problem should present little difficulty, for besides the considerable number of State plants, there are now in the country a large number of well-equipped private firms producing serum in large quantities, and these, with the State plants, are capable of supplying any demand that is likely to arise.

COST OF CARRYING ON THE WORK.

It may be well in conclusion to say a few words concerning the cost of carrying out a plan such as that here suggested. It would probably be unwise to attempt to cover the entire country at the very beginning, for work of this kind is best done by experienced men who will proceed carefully and thus avoid the annoyances and confusion that would follow hasty or ill-advised action. Men of this type are not readily procured. Therefore it will be best to make a slow start, first giving attention to certain sections of a State, and when these are properly organized, proceeding to another. With this idea in mind it is suggested that the Federal Government might supply a force of 50 or 60 skilled men for field service at an annual cost, at the beginning, of about $200,000. This would enable the Federal Government to place 3 men in each of about 20 States. The States at the same time should supply for education and organization at least as many men as the Federal Government, and double the number would perhaps better fit the needs of the case. On the basis of an equal number, each State would need an appropriation of $10,000 annually for this work, and an equal sum should be available for the use of the State veterinarian in the campaign for improved sanitation. The cost of the needed serum should of course be borne by the farmers themselves.

This is a very modest program for dealing with a disease which annually causes losses amounting to many millions of dollars. However, it is believed best to proceed slowly and surely and in such a way that the farmers may be encouraged to do the greater part of the work themselves.

This discussion should not be closed without laying emphasis upon the importance of further research on the cause, modes of dissemination, and methods of preventing hog cholera. While complete eradication does not seem feasible at the present time, it is entirely possible that further research may enable us to discover means whereby complete elimination of the disease may be eventually realized. This, of course, is the end for which all concerned should continually strive. Both Federal and State Governments should provide for research along the lines indicated.

SUMMARY.

1. No feasible plan has yet been devised for the complete eradication of hog cholera, yet it is entirely possible to control the losses from the disease and thus place hog raising upon a relatively stable basis, freed for the most part from the cholera menace which has been for so many years the bugbear of swine growers.

2. The plan of slaughter of infected herds with strict quarantine and disinfection of premises, such as has been pursued successfully in combating foot-and-mouth disease, is entirely unsuitable for the control or eradication of hog cholera in the United States.

3. A campaign of education with the prompt and intelligent use of serum[1] increases the interest and confidence of farmers in hog raising and results in reduction of losses and greatly increased hog production.

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[1] The methods of administering serum are described in Farmers' Bulletin 834, "Hog Cholera: Prevention and Treatment," to which the reader is referred for a discussion of the "simultaneous" and "serum-alone" methods of treatment.

4. Potent anti-hog cholera serum, if used promptly and intelligently on infected herds, will save a large portion of hogs which would otherwise succumb.

5. To combat the disease successfully and carry out the program herein outlined, there must be hearty cooperation between farmers and swine raisers, State authorities (colleges, live-stock sanitary boards, and State veterinarians), and the Federal Department of Agriculture. With this assured, the scourge of hog cholera should be gradually but surely overcome.

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